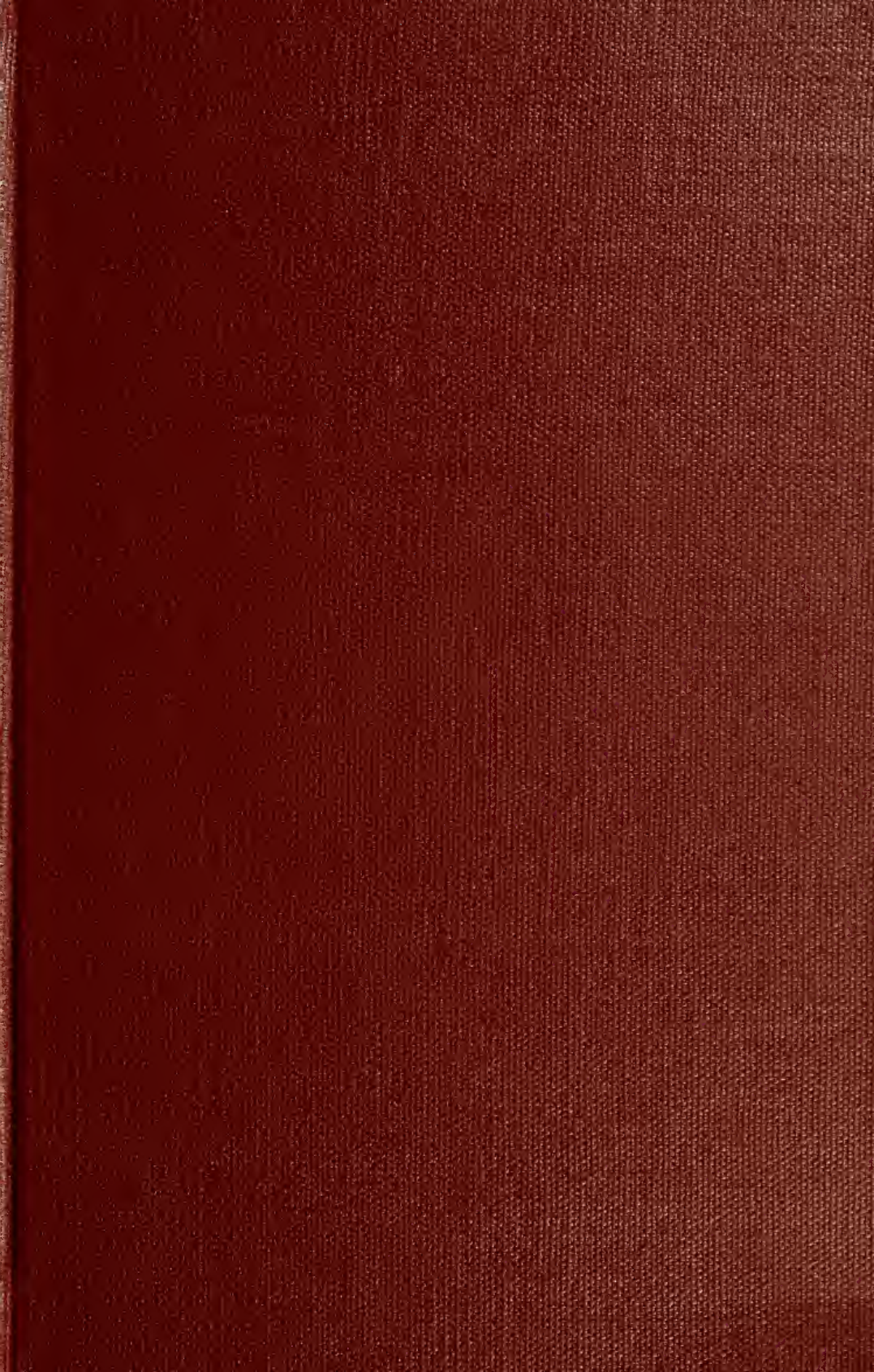




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NEW SPECIES OF FROGS (LEPTODACTYLIDAE: *ELEUTHERODACTYLUS*) FROM THE PACIFIC VERSANT OF ECUADOR

By

JOHN D. LYNCH¹

In 1966 William E. Duellman collected briefly at Tandapi, Provincia Pichincha, Ecuador, a village on the Pacific versant of the Andes at 1460 m elevation. The locality lies within cloud forest and Duellman's brief visit suggested a rich fauna might be revealed by extensive field work. At his suggestion, I collected at Tandapi in July, 1967, March and August, 1968, and August, 1970. More than 1000 specimens of 20 amphibians and six reptiles were secured, including eight species of *Eleutherodactylus*. The Tandapi faunule is as diverse as the subparamo faunule east of Loja (Lynch, MS) but only half as diverse as the Amazonian lowland faunule at Lago Agrio and Santa Cecilia (Lynch, 1974a). At present more eleutherodactyline species are known from Tandapi than from any other locality on the Pacific versant of Ecuador. Collections have been made at La Delicia (Imbabura Prov., 2700 m), Apuela (Imbabura Prov., 1650 m), Los Alpes (Pichincha Prov., 2500 m), Las Palmas (Pichincha Prov., 920 m), Pilalo (Cotopaxi Prov., 2200 m), and Balzapamba (Bolivar Prov., 800 m). Some interlocality faunal connections were established, but for the most part the faunules are discrete.

All eight eleutherodactyline species found at Tandapi were collected in the first ten days of field work. On later visits some species were more abundant than on the first; four species (two ground-

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dwelling and two aboreal) were the most abundant on all four trips.

Three species are members of the *E. fitzingeri* group (Group I of Cochran and Goin, 1970); these include *Eleutherodactylus achatinus* (Boulenger), *E. w-nigrum* (Boettger), and one undescribed species. The other five species are members of the *E. unistrigatus* group (Group II of Cochran and Goin, 1970); these include *E. crucifer* (Boulenger) and four undescribed species.

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Sr. Teodoro Heredia and his family at Tandapi were my most gracious hosts. For aid in the field I am grateful to Sr. Wilson Pazmiño, Robert Henderson, G. R. Smith, and especially my wife, Marsha. Jaime Pefaur kindly provided the Spanish summary.

Abbreviations for collections used throughout the text are:

BMNH British Museum (Natural History)

KU The University of Kansas Museum of Natural History

MCZ Museum of Comparative Zoology

ACCOUNTS OF SPECIES

Eleutherodactylus crenunguis new species

Fig. 1A

Holotype.—KU 120126, adult male collected at Tandapi, Prov. Pichincha, Ecuador, 1460 m, 28 July 1968 by John D. Lynch.

Paratypes.—KU 111213, 111215, 120127-31, 131605, all topotypes.

Diagnosis.—(1) skin of dorsum finely shagreened with scattered warts and occipital ridges, no dorsolateral folds, that of venter smooth, discoidal folds prominent; (2) tympanum distinct, round, its length $1\frac{1}{3}$ - $2\frac{1}{5}$ that of eye; (3) snout subacuminate in dorsal view, rounded in lateral profile, long; lips flared; (4) interorbital space flat, small cranial crests, upper eyelid much broader than IOD; (5) prevomerine odontophores large, triangular; (6) males with weakly bilobed subgular vocal sac and short vocal slits; (7) first finger markedly longer than second; fingers bearing discs on broadly

dilated pads, dorsal surface of pad weakly bilobate; pads of outer fingers much larger than those of inner fingers; (8) fingers lacking lateral fringes; (9) no ulnar tubercles except antebrachial; (10) small conical tubercles on heel and outer edge of tarsus; (11) two metatarsal tubercles, inner 4-6 times size of round outer; few supernumerary plantar tubercles; (12) toes lacking lateral fringes and webbing; toe pads smaller than those on fingers; (13) gray with brown blotch on back, flanks gray flecked with black, venter creamy-white marbled with brown; limb bars thin and oblique; posterior thigh black with cream flecks; in life brown with rusty-orange markings, venter pale orange reticulated with brown; (14) adults large; males 35.2-49.2 mm SVL, adult females not known.

E. crenunguis is a member of Cochran and Goin's (1970) Group I and among the species of that group unique in having flared lips. The most distinctive feature is the notch in the skin above the apical margin of the disc. Such digital configuration is similar to that in most, if not all, of the species of the genus found in south-eastern Brasil. None of the Brazilian species (*E. binotatus*, *E. guentheri*, *E. lacteus*, and *E. parvus* groups) have flared lips. The broadly flared lips resemble the condition seen in *E. cruentus* (Peters) and *E. latidiscus* (Boulenger). These species have broadly dilated digital pads and the pads are emarginate. Both differ from *E. crenunguis* in having areolate skin on the venter, a short first finger (shorter than second), and lateral fringes on the digits.

Description.—Head broader than body, wider than long; head width 38.9-41.8 ($\bar{x}$ = 40.4, N = 11)% SVL; snout subacuminate in dorsal view, rounded in lateral profile; snout long, E-N 89.4-107.8 ($\bar{x}$ = 100.4, N = 9)% eye length; canthus rostralis prominent, round; loreal region markedly concave, sloping gradually to flared lips; nostrils weakly protuberant, directed laterally; interorbital space flat although small cranial ridges are palpable; upper eyelid width 118.8-141.7 ($\bar{x}$ = 128.7, N = 9)% IOD; tympanum small, round, its upper edge concealed by indefinite supratympanic fold, its length 28.0-39.3 ($\bar{x}$ = 33.4, N = 9)% eye length; temporal region sloping; upper eyelid bearing small, non-conical tubercles; choanae longer than wide, not concealed by palatal shelf of maxillary arch; prevomerine odontophores triangular in outline, median and posterior to choanae, separated by one-half width of an odontophore, each bearing 8-10 teeth in a weakly arched row across posterior edge; tongue slightly longer than wide, its posterior edge notched, posterior 2/5 not adherent to floor of mouth; vocal slits short, well lateral to tongue on floor of mouth; vocal sac weakly bilobate.

Skin of dorsum finely shagreened with scattered warts; W-shaped ridge on occiput; prominent interorbital tubercle; indefinite dorsolateral folds on anterior one-half of body; anal opening not extended in sheath; lower flanks bearing large, flat areolations; skin

of venter smooth, discoidal folds prominent; skin posterior and lateral to anus bearing large, flat areolations; upper limbs smooth with scattered warts; no ulnar fringe or tubercles except for antebrachial; one flat, bifid palmar tubercle, slightly larger than oval thenar tubercle; palm bearing flat supernumerary tubercles distal to basal subarticular tubercles; subarticular tubercles non-conical, round to longer than wide; fingers lacking lateral fringes; all digits bearing pads, those on III and IV markedly larger than those on I and II; dilation ratios for hand: I 1.5 (1.4-1.9), II 2.1 (1.5-2.7), III 3.1 (2.9-3.4), IV 2.9 (2.7-3.1); discs wider than long; ungual flap emarginate, dorsal surface of pad bilobate (Fig. 2); first finger longer than second; all fingers long and slender.

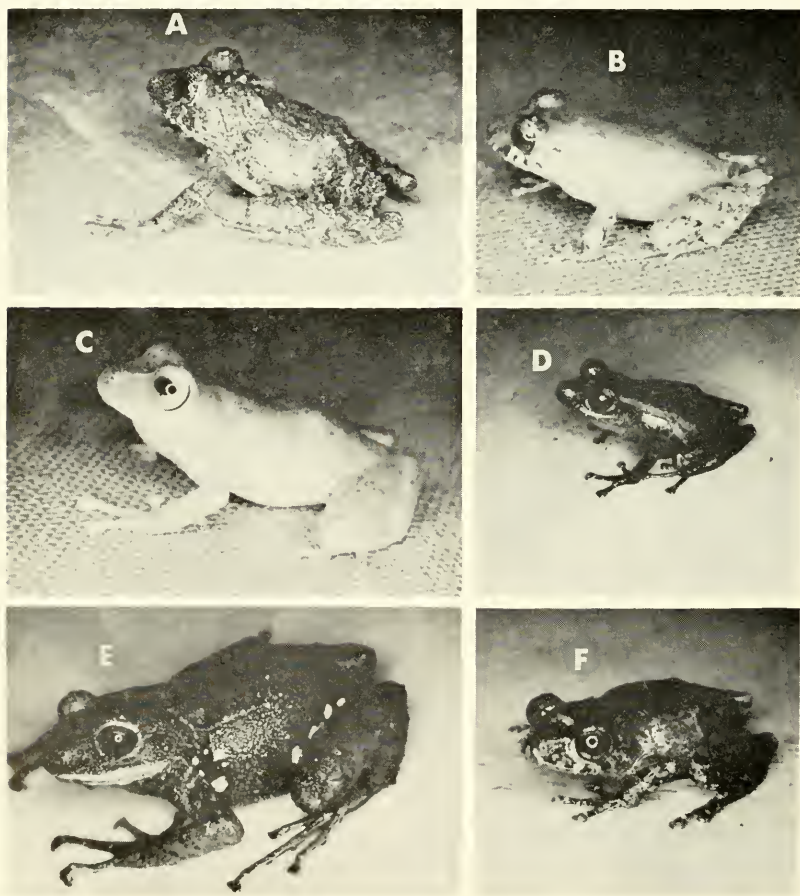


FIG. 1.—A, *Eleutherodactylus crenuguis*, KU 111214, ♂ 24.2 mm SVL; B, *E. calcarulatus*, KU 131674, ♂ 23.2 mm SVL; C, *E. nyctophylax*; D, *E. luteolateralis*, KU 131674, ♀ 28.8 mm SVL; E, *E. thymalopsoides*, KU 131533, ♀ 55.3 mm SVL; F, *E. parvillus*, KU 131604, ♀ 23.6 mm SVL.

Heel bearing small, conical tubercle on its upper edge; outer edge of tarsus bearing small, conical tubercles; no tubercles or folds on inner edge of tarsus; outer metatarsal tubercle round, non-conical, 1/4-1/6 size of elongate (2 1/2-3 times as long as wide), non-compressed inner metatarsal tubercle; plantar surface bearing prominent supernumerary tubercles at bases of toes II-IV; subarticular tubercles longer than wide (or round), non-conical, slightly smaller than those of fingers; toes lacking lateral fringes; toes bearing prominent pads, that on I smallest, all smaller than those of fingers; discs broader than long; pads emarginate; heels overlapping when flexed legs are held at right angles to sagittal plane; heel of adpressed limb extends beyond tip of snout; shank 55.3-61.9 ($\bar{x}$ = 57.4, N = 11)% SVL.

In preservative, the ground color is gray with brownish-gray blotches on center of back; warts edged with black and dull cream; flanks gray flecked with black and sparsely with cream grading into chocolate-brown in the groin; posterior thigh black, chocolate-brown, or dark brown with cream punctations; limbs gray-brown with black bars; bars on shank thin and oblique; lips barred; canthal stripe brown; undersides of limbs brown spotted with cream; venter creamy-white with sparse brown marbling; throat cream, sparsely stippled with brown and reticulated with brown.

In life, *E. crenunguis* is brown to reddish-brown above with darker brown markings and a rust-wash; the back may be spotted with dull yellow or orange. The undersides of the limbs are black or brown spotted with white. The venter is dull orange or yellow mottled with gray. The throat is gray to black mottled with dull white. The posterior surface of the thigh is black flecked with white. The iris is gold to bronze above, gray-brown below, finely reticulated with black, and has a horizontal brown streak.

Measurements of holotype in mm.—SVL 49.2; shank 28.4; head width 19.4; upper eyelid width 5.0; IOD 4.0; tympanum length 2.0; eye length 5.9; E-N 6.1.

Etymology.—Latin, *crena* (notch) and *unguis* (nail), in reference to the emarginate pads on the digits.

Natural history.—Only eleven specimens of *E. crenunguis* have been found. All five females are immature. Three of the individuals were found on the ground; the other eight were found on low herbs within 0.5 m of the forest floor. All of the individuals found on the ground were found at the forest-edge. I never found this species during the day—all specimens were active at night. *Eleutherodactylus achatinus* was active by day, hopping in more open areas. The other *E. fitzingeri* group species, *E. w-nigrum*, is nocturnal and usually terrestrial. On the basis of the size of adult males, *E. crenunguis* may be larger than *E. w-nigrum* (σ δ 26.2-

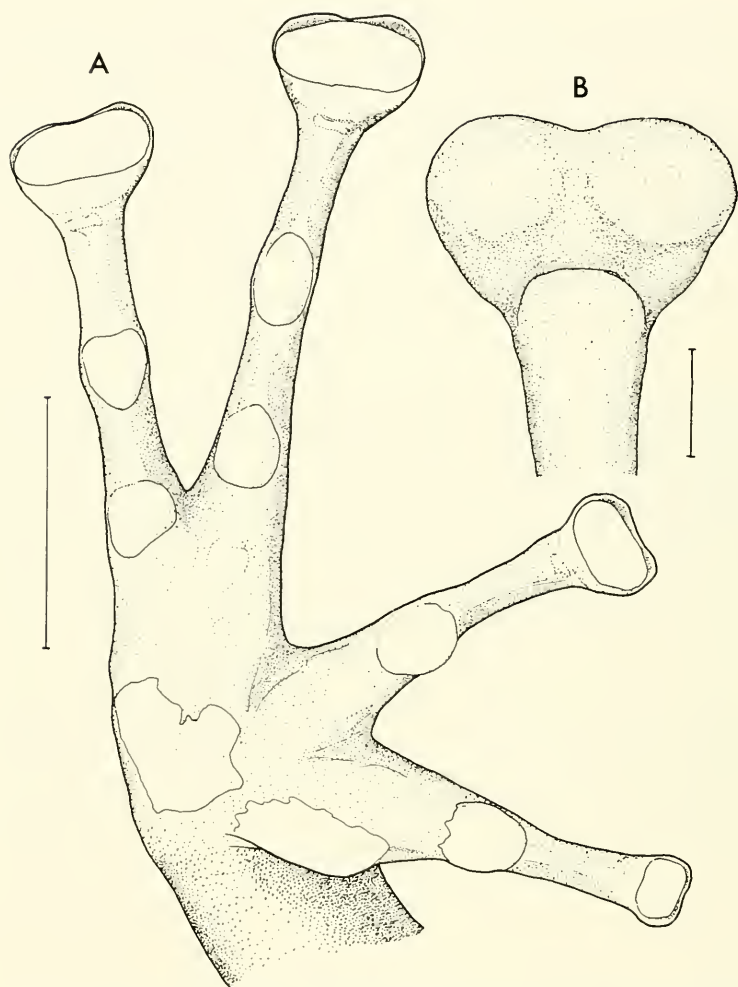


FIG. 2.—Ventral view of hand of *Eleutherodactylus crenunguis* (KU 120126, A; line equals 5 mm); dorsal view of pad of third right finger (KU 120128, B, line equals 1 mm).

46.1, ♀ ♀ 50.2-69.0 mm SVL) and clearly is larger than *E. achatinus* (♂ ♂ 25.9-34.2, ♀ ♀ 37.6-45.5 mm SVL).

Distribution.—Known only from the type locality.

Eleutherodactylus calcarulatus new species

Fig. 1B

Holotype.—KU 111218, adult female, collected at Tandapi, Prov. Pichincha, Ecuador, 1460 m, 15 July 1967 by John D. Lynch.

Paratypes.—KU 111216-17, 111220-21, 111223-30, 111232-40,

111242-50, topotypes collected 15-24 July 1967 by J. D. and M. Lynch. MCZ 75170-71, 75175-77, topotypes.

Diagnosis.—(1) skin of dorsum smooth or bearing low, flat granulations, no dorsolateral folds, that of venter coarsely areolate, discoidal folds prominent; (2) tympanum distinct, round, its length $1/4$ - $2/5$ that of eye; (3) snout subacuminate in dorsal view, rounded in lateral profile, bearing papilla at tip; (4) interorbital space flat, no cranial crests; upper eyelid slightly wider than IOD; (5) prevomerine odontophores oblique; (6) males with subgular vocal sac and vocal slits; (7) first finger shorter than second; all fingers bearing discs on dilated pads, pads round apically; (8) fingers bearing keel-like lateral fringes; (9) ulnar tubercles small, conical; (10) heel bearing elongate conical tubercle; tarsus bearing small conical tubercles; one large inner tarsal tubercle; (11) two metatarsal tubercles, inner oval, 4-6 times size of oval outer; few supernumerary plantar tubercles; (12) toes with narrow lateral fringes, no webbing, toe pads as large as those of fingers; (13) pale brown with brown markings, *viz.*, interorbital bar, chevrons, canthal and supratympanic stripes, labial bars, oblique limb bars; venter cream peppered with brown; posterior surfaces of thigh uniform brown; (14) adults small, males 17.8-24.6 mm, females 25.3-28.9 mm SVL.

The presence of an elongate heel tubercle sets *E. calcarulatus* apart from most other Group II eleutherodactyli. Most species having such a calcar also have elongate tubercles on the eyelid, forearm, and outer edge of the tarsus. In *E. calcarulatus* these accessory tubercles are small thereby distinguishing the species from *E. appendiculatus* (Werner), *E. calcaratus* (Boulenger), *E. crucifer* (Boulenger), *E. galdi* (Jiménez da la Espada), *E. orocostalis* Rivero, and *E. rubicundus* (Jiménez de la Espada). *E. quaquaversus* Lynch has a similar tubercle arrangement but differs from *E. calcarulatus* in having triangular prevomerine odontophores. *E. frater* (Werner), *E. ockendeni* (Boulenger), and *E. taeniatus* (Boulenger) are probably the closest relatives of *E. calcarulatus*; all are readily separable in that none has so large a heel tubercle as *E. calcarulatus*.

Description.—Head as broad as body, broader than long; head width 33.2-37.6 ($\bar{x}$ = 34.9, N = 21)% SVL in males, 33.6-36.7 ($\bar{x}$ = 35.2, N = 20) in females; snout subacuminate in dorsal view, round in lateral profile, papilla at tip; canthus rostralis moderately sharp, concave; loreal region weakly concave, sloping gradually to non-flared lips; nostril weakly protuberant, directed dorsolaterally; snout short, E-N 81.0-98.2 ($\bar{x}$ = 86.6, N = 21)% eye length in males, 75.7-95.3 ($\bar{x}$ = 85.3, N = 20) in females; interorbital space flat, no cranial crests; upper eyelid width 76.1-108.9 ($\bar{x}$ = 96.0, N = 21)% IOD in males, 83.3-118.0 ($\bar{x}$ = 101.1, N = 20) in females; supratympanic fold not prominent, concealing upper edge of tympanum; tympanum round, distinct, its length 25.4-38.5 ($\bar{x}$ = 31.4, N = 21)% eye

length in males, 24.3-38.9 ($\bar{x}$ = 29.5, N = 20) in females; separated from eye by distance equal its own diameter; temporal region nearly vertical; choanae slightly longer than wide, moderate-sized, not concealed by palatal shelf of maxillary arch; prevomerine odontophores median and posterior to choanae, oblique, bearing 1-5 teeth in a slanted row, separated by a distance slightly greater than choanal width, each 1 1/2-2 times size of a choana; tongue longer than wide, feebly notched along posterior border, posterior 2/5 not adherent to floor of mouth; males with subgular vocal sac and short vocal slits posterolateral to tongue.

Skin of dorsum smooth or bearing low, flat granulations (almost shagreened); one or two round warts on upper eyelid; no dorsolateral folds; flanks smooth; anus lacking sheath; venter coarsely areolate; discoidal folds prominent; skin on posterior thigh surface near vent coarsely areolate; forearm bearing series of ulnar tubercles (antebrachial largest); palmar tubercle bifid, larger than oval thenar tubercle; many supernumerary palmar tubercles, none prominent, all smaller than round, non-conical subarticular tubercles; fingers bearing narrow, keel-like lateral fringes; all fingers bearing dilated pads and discs (discs broader than long); dilation ratios: I 1.4 (1.3-1.6), II 1.9 (1.7-2.1), III 2.2 (2.0-2.4), IV 2.2 (2.1-2.5); pads rounded apically; first finger shorter than second.

Knee tuberculate, none large; heel bearing a large conical tubercle and several small, non-conical tubercles; outer edge of tarsus bearing series of non-conical tubercles; inner edge of tarsus bearing one elongate tubercle proximal to inner metatarsal tubercle; outer metatarsal tubercle longer than wide, conical, 1/4-1/6 size of elongate (length 2 1/2-3 times width), non-compressed inner metatarsal tubercles; plantar surface bearing a few indefinite supernumerary tubercles at bases of toes II-IV; subarticular tubercles like those of fingers; toes bearing narrow lateral fringe, not basally webbed; toe pads as large as those of fingers, none as small as that of thumb; discs broader than long; heel of adpressed hind limb reaches nostril; shank 46.7-57.3 ($\bar{x}$ = 51.4, N = 21)% SVL in males, 45.5-53.0 ($\bar{x}$ = 50.0, N = 20) in females.

Most specimens (59/73) exhibit the following color pattern: In preservative, ground color cream, pale brown, or dark brown with brown markings (*viz.*, interorbital bar, chevrons, suprainguinal spots, canthal and supratympanic stripes, labial bars, and limb bars); anal triangle brown to black edged with cream; shank bars oblique, as wide as interspaces; interspaces sometimes divided by thin oblique bar; posterior surface of thighs uniform brown; flanks suffused with gray and bearing slanted brown bars (or not); venter dirty cream peppered with brown; edge of lower jaw sometimes has brown dashes; undersides of limbs darker than venter; anterior surface of thigh brown.

Five of 73 specimens have a pattern of brown longitudinal stripes. Seven others have a narrow middorsal stripe (cream in preservative). One individual has the entire dorsal surface cream-colored (a *dorsoconcolor* pattern, Lynch, 1965) and another has a dorsal pattern resembling that of *Hyla leucophyllata*.

In life, *E. calcarulatus* is yellowish, greenish, or reddish brown with a black or brown pattern. The flanks are paler. The vocal sac of males is bright yellow. The venter is pale yellow to greenish-brown flecked with cream. The posterior thigh is dull gray. In those having a middorsal stripe, the stripe is green or orange. The iris is blue-gray, flecked with black, and bears a reddish-brown horizontal streak.

Measurements of holotype in mm.—SVL 26.0; shank 13.4; head width 8.9; upper eyelid width 2.2; IOD 2.2; tympanum length 0.9; eye length 3.4; E-N 3.0. The holotype is an adult female with extensively convoluted oviducts and large, yellow ovarian eggs.

Etymology.—Latin, diminutive, in reference to the conical heel tubercle.

Natural history.—*E. calcarulatus* is a nocturnal, arboreal frog. Specimens were collected on low herbs as well as up to 2 m on vegetation at the forest edge. Few specimens were taken in dense forest. By day, specimens were encountered in the axils of elephant ear plants and beneath bark. No calling was heard that could be attributed to this species. The smallest adult female collected is 25.3 mm SVL; the largest female having weakly-developed oviducts and small eggs is 26.0 mm. The largest female with non-convoluted oviducts is 25.0 mm SVL. Gravid females were collected in March, July, and August.

Distribution.—In addition to material from the type locality, a small series was secured at La Delicia, Imbabura Prov., Ecuador, 2700 m. This locality lies within cloud forest as well.

***Eleutherodactylus crucifer* (Boulenger)**

Hylodes crucifer Boulenger, 1899:456 [Holotype.—BM 1899.10.30.45/RR 1947.2.16.91 from Porvenir, Prov. Bolivar, Ecuador, P. O. Simons collector].
Eleutherodactylus crucifer: Peters, 1955:337.

Diagnosis.—(1) skin of dorsum finely tuberculate with scattered conical warts on eyelids, between eyes, on back, and shanks; skin of venter coarsely areolate; no dorsolateral folds; discoidal folds prominent; (2) tympanum prominent, round to higher than long, its length 1/4 to 1/3 that of eye; (3) snout round in dorsal view, truncate in lateral profile, very short; (4) interorbital space flat, no cranial crests, narrower than upper eyelid; (5) prevomerine odontophores present, triangular in outline, as large as or larger than choanae; (6) males with external vocal sac and long vocal slits; (7) first finger shorter than second; pads and discs on all fingers,

those on fingers 3 and 4 largest; pads round at tips; (8) fingers bearing crenulated lateral fringes; subarticular tubercles round; (9) ulnar tubercles conical; (10) conical tubercles on knee and one or two elongate tubercles on heel; conical tubercles along inner and outer edges of tarsus; (11) two metatarsal tubercles; outer round, $1/4-1/6$ size of oval inner; plantar surface areolate; (12) toes bearing crenulate lateral fringes; (13) cream with brown interorbital triangle, occipital W, sacral chevron, suprainguinal chevron, canthal and supratympanic stripes, labial bars, flank bars, oblique limb bars, and anal triangle; venter cream, lightly to heavily flecked with dark gray; in life, metallic green with brown to black markings; groin, anterior and posterior thighs, and concealed shank deep blue; (14) adults small, males 18.3-20.6 mm, females 26.2-28.5 mm SVL.

The only species with which *E. crucifer* is likely to be confused is *E. calcaratus* (Boulenger) found on the Pacific versant of the Cordillera Occidental in Colombia. The two frogs have essentially the same body proportions, distribution of warts, and coloration in preservative. *E. calcaratus* has a longer tubercle on the heel and does not have crenulated lateral fringes on the digits. *E. crucifer* may also be confused with young specimens of *E. galdi* (Jiménez de la Espada) found on the Amazonian versant of the Ecuadorian Andes. The interorbital region is broader in *E. galdi* and cranial crests develop in larger individuals. *E. galdi* has a longer snout, lacks crenulate fringes on the digits, and has some large granular warts intermixed with the areolations on the venter.

Description.—(Based on material from Tandapi). Head broader than body, broader than long; head width 34.7-38.5 ($\bar{x} = 37.0$, $N = 9$)% SVL in males, 38.7-42.0 ($\bar{x} = 40.3$, $N = 5$) in females; snout rounded in dorsal view, truncate or rounded in lateral profile, tip not pointed or keeled; snout short, E-N 65.5-80.0 ($\bar{x} = 70.5$, $N = 8$)% eye length in males, 77.5-84.2 ($\bar{x} = 81.2$, $N = 5$) in females; nostrils weakly protuberant, directed laterally, canthus rostralis sharp, concave; loreal region weakly concave, sloping gently to lips; lips weakly flared; interorbital space flat, no cranial crests; upper eyelid width 100.0-127.9 ($\bar{x} = 111.1$, $N = 8$)% IOD in males, 104.8-130.8 ($\bar{x} = 118.7$, $N = 5$) in females; tympanum separated from eye by distance equal twice tympanic length; conical warts on upper eyelid, between eyes, about ear, and along lower jaw (in small individuals only); choanae moderate-sized, round, not concealed by palatal shelf of maxillary arch when roof of mouth is viewed from directly above; prevomerine odontophores as large as choanae in smaller individuals (all males), larger than choanae in large females; odontophores median and posterior to choanae, elevated, triangular in outline, bearing a row of 3-7 teeth along posterior edge, narrowly separated (by distance equalling $1/4-1/2$ odontophore width); tongue longer than wide, its posterior border weakly notched, pos-

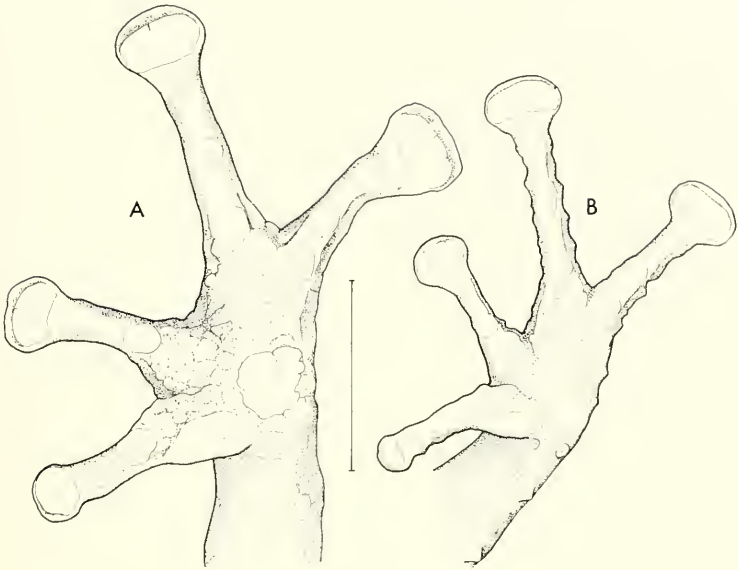


FIG. 3.—Hands of (A) *Elcutherodactylus nyctophylax* (KU 110955); (B) *E. crucifer* (KU 120134). Line equals 5 mm.

terior 1/3-1/2 not adherent to floor of mouth; long vocal slits posterolateral to tongue in males; vocal sac median, external.

Skin of dorsum finely tuberculate (not shagreened) with larger, mostly conical, warts on upper eyelid, between eyes, on occipital region, scattered on back; no dorsolateral folds; flanks weakly areolate, venter coarsely areolate; discoidal folds prominent; skin of thigh and upper arm smooth; shank and forearm finely tuberculate with large conical warts; skin below vent coarsely areolate; vent not extended by skin folds; forearm bearing a series of conical ulnar warts sometimes so closely spaced to appear as a crenulate ridge; palmar tubercle bifid, larger than oval thenar tubercle; palm areolate; fingers bearing crenulate lateral fringes (Fig. 3); subarticular tubercles moderate-sized, round, simple, fingers bearing discs (wider than long) on pads, pad on thumb smaller than those on outer fingers, all pads rounded apically; first finger shorter than second.

Knee bearing conical tubercle; heels bearing one or more elongate tubercles; tarsus bearing rows of conical tubercles along inner and outer edges; a larger non-conical inner metatarsal tubercle median to inner row of tarsal tubercles occurs just proximal to inner metatarsal tubercle; inner metatarsal tubercle oval, non-compressed, 4-6 times size of round, non-conical outer metatarsal tubercle; numerous plantar supernumerary tubercles, some larger than others, all smaller than subarticular tubercles; subarticular

tubercles round, simple, same size as those of fingers; toes bearing crenulate lateral fringes (outer edge of fifth toe also bearing crenulate fringe); all toes bearing discs on pads, tips rounded; toe pads smaller than those of fingers; hind limbs of moderate length; heels overlapping when hind legs are flexed at right angles to sagittal plane; heel of adpressed hind limb reaching to between eye and nostril; shank 54.0-59.6 ($\bar{x}$ = 56.1, N = 9)% SVL in males, 48.6-56.9 ($\bar{x}$ = 52.6, N = 5) in females.

Color in preservative.—Ground color dull white to cream; dorsum bearing brown markings infused with black, *viz.*, interorbital triangle, occipital W, sacral and suprainguinal chevrons; canthal and supratympanic stripes distinct; labial bars present; flanks bearing broad blotch anteriorly, contiguous with supratympanic stripe; upper flanks blotched (in darker individuals the spots are continued ventrally as oblique bars); limbs barred, bars weakly oblique on shank, about as wide as interspaces; anal triangle brown; posterior thigh cream reticulated with brown except behind knee (colorless); anterior thigh, groin, and concealed shank pigmentless; venter cream, lightly to heavily flecked with gray.

Color in life.—Bright metallic green above with dark green and black markings; venter dull cream spotted with brown; throat creamy-white spotted with brown; groin, distal concealed thighs, and underside of shank dark blue; most of posterior thigh cream with fine brown reticulation; iris red with brown horizontal streak and white-bronze lower portion.

Variation.—Small individuals (less than 17 mm SVL) tend to be more markedly tuberculate than are larger individuals. In larger specimens the tubercles are conical whereas in smaller individuals the tubercles are proportionately longer. Small individuals have lower, more oval and oblique prevomerine odontophores. Small adults have blue areas on the groin, posterior thighs, and concealed shanks, but these areas are a paler blue than seen in larger adults. In juveniles, the blue areas are pale blue-green, and before I encountered adults I had not noted the blue pigment. The smallest individuals (less than 12.0 mm SVL) have pale green coloration in the areas that are blue-black in adults. Smaller individuals have pale green ventral surfaces with little or no spotting. The red coloration of the iris is not evident in small specimens where the iris tends to be chalk-white.

Natural history.—All specimens of *E. crucifer* taken at Tandapi (22) were found in dense forest. All of the other species found at the locality were at least occasionally found along the forest edge (along trails, pastures, etc.). No calls were heard that could be attributed to *E. crucifer*. Three females are gravid; these were collected in August. The largest non-adult female (straight, thin oviducts; minute, white eggs) is 19.4 mm SVL. Males as small as

16.1 mm have vocal slits. Fifteen of the specimens were collected in dense forest along the Río Cariaco, approximately 1/2 km E of Tandapi. The frogs were found at night sitting on broad leaves covered with moss. Against the spiny and tuberculate background the frogs were nearly invisible. The seven specimens found elsewhere in the forests were found on leaves lacking mossy upper surfaces. Three small individuals (KU 111210-12, 8-12 mm SVL) were collected on nettle leaves.

Remarks.—*E. crucifer* is known from only three localities on the Pacific versant of Ecuador. The type locality lies at about 1800 m (letter from P. O. Simons to O. Thomas) and was described by the collector as being equivalent to the forests near Mirador (vicinity of Baños, Prov. Tungurahua, Ecuador). The apparent rarity of this frog reflects two points—few Pacific slope cloud forest localities have been worked in Ecuador, and protective coloration and tubercularity renders the frogs well concealed on moss-covered leaves.

Distribution.—Known only from near Tandapi and the type locality, in cloud forest habitats and at elevations of 1460-1760 m.

***Eleutherodactylus luteolateralis* new species**

Fig. 1D

Holotype.—KU 131674, adult female collected at Tandapi, Prov. Pichincha, Ecuador, 1460 m, 6 August 1970 by John D. Lynch.

Paratypes.—KU 111378-84, 120151-54, 131672-73, 131675-77, 135448-51, all topotypes.

Diagnosis.—(1) skin of dorsum coarsely shagreened and bearing many fine ridges, no dorsolateral folds, that of venter coarsely areolate, discoidal folds prominent; (2) tympanum prominent, round, its length 1/4-1/3 that of eye; (3) snout subacuminate in dorsal view, rounded in lateral profile; (4) upper eyelid slightly broader than interorbital distance; no cranial crests; (5) prevomerine odontophores oblique; (6) males with subgular vocal sac and vocal slits; (7) first finger shorter than second; fingers bearing discs on broad pads; (8) fingers bearing narrow lateral fringes; (9) no ulnar tubercles except antebrachial; (10) small tubercles on knee and heel, heel bearing one enlarged, non-conical tubercle; tarsus lacking tubercles; (11) two metatarsal tubercles, inner subconical, oval, 2 1/2-3 times size oval outer; numerous plantar supernumerary tubercles; (12) toes bearing narrow lateral fringes; toes bearing discs on pads, pads smaller than those of fingers; (13) dorsum gray with pale and dark brown stripes; pale dorsolateral bands from eye obliquely along flank to groin; limbs barred, shank bars oblique; venter cream speckled with brown; lower flanks, groin, anterior thighs, and concealed shank brown with cream spots edged with black; posterior thigh brown (rarely with cream spots); cream spots lemon-yellow

in life; (14) adults small, males 16.6-23.6 mm, females 25.6-29.5 mm SVL.

E. luteolateralis is most similar to *E. walkeri*. In most structural features the two are identical. *E. luteolateralis* has more extensive plantar supernumerary tubercles, has a series of fine ridges on the dorsum, larger outer metatarsal tubercle, and is larger than *E. walkeri* ($\delta \delta$ 15.3-17.9 mm, $\phi \phi$ 20.8-25.3 mm SVL). The color patterns of the two are similar but *E. walkeri* is polymorphic and less than 13% of the individuals in the sampled populations have striped patterns. All other specimens of *E. walkeri* have a dorsal pattern including chevrons and interorbital bar.

Description.—Head as broad as to slightly narrower than body, broader than long; head width 33.3-40.1 ($\bar{x}$ = 35.9, N = 21)% SVL; snout subacuminate in dorsal view, rounded in lateral profile, tip of snout bearing vertical keel; upper jaw overhanging lower; nostrils protuberant, directed dorsolaterally; snout short, E-N 70.1-96.4 ($\bar{x}$ = 83.0, N = 10)% eye length in males, 82.8-100.0 ($\bar{x}$ = 89.9, N = 10) in females; canthus rostralis moderately sharp, concave; loreal region concave, sloping gradually to non-flared lips; interorbital space flat, no cranial crests; upper eyelid width 88.6-130.0 ($\bar{x}$ = 104.6, N = 18)% IOD; supratympanic fold thick, concealing upper edge of tympanum; temporal region nearly vertical; tympanum prominent, round, separated from eye by one-half its own diameter, its length 21.7-32.1 ($\bar{x}$ = 27.2, N = 10)% eye length in males, 24.7-38.4 ($\bar{x}$ = 31.7, N = 10) in females; no warts on upper eyelid or head; choanae slightly longer than wide to round, as large as an odontophore; not concealed by palatal shelf of maxillary arch; prevomerine odontophores median and posterior to choanae, oblique, separated by choanal width, bearing 1-5 teeth in a slanted row; tongue as long as wide, its posterior edge notched, posterior one-half not adherent to floor of mouth; males with subgular vocal sac and short vocal slits.

Skin of dorsum coarsely shagreened bearing many fine ridges on back; flanks weakly areolate, venter coarsely areolate; anal opening not extended in sheath; discoidal folds prominent; forearm lacking ulnar tubercles except for antebrachial; palmar tubercle bifid or separated into small outer and large inner palmar tubercles, neither as large as oval thenar tubercle; supernumerary palmar tubercles numerous, distinct, subconical, some nearly as large as round, subconical subarticular tubercles; fingers bearing narrow lateral fringes, discs (broader than long), and round pads; pads on outer fingers largest; dilation ratios: I 1.6 (1.3-2.4), II 2.4 (2.2-2.8), III 2.7 (2.5-3.2), IV 2.6 (2.4-3.0); first finger shorter than second.

Small, non-conical tubercles on knee and heel; tarsal tubercles, if present, small and indistinct; outer metatarsal tubercle elongate, subconical, 1/3-1/4 size of elongate (length twice width), non-

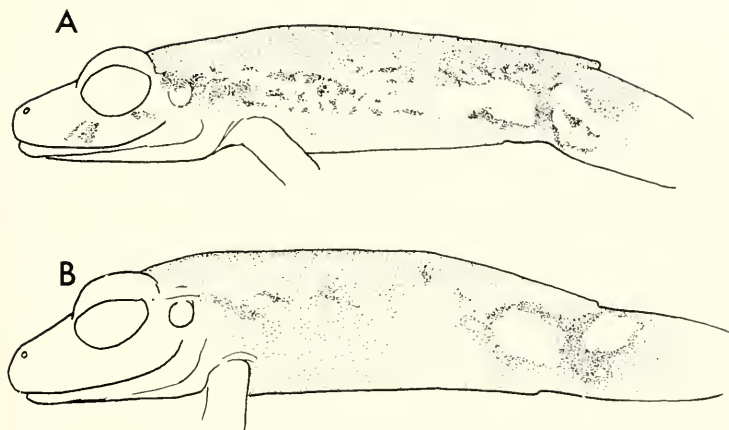


FIG. 4.—Flank patterns of (A) *Eleutherodactylus luteolateralis*, KU 120153, 21.7 mm SVL; (B) *E. walkeri*, KU 120221, 22.3 mm SVL.

compressed inner metatarsal tubercle; many supernumerary plantar tubercles in rows on metatarsals, none as large as subarticular tubercles (like those of fingers); toes bearing distinct, narrow lateral fringes, lacking webbing; toe pads slightly smaller than those of fingers, all bearing broader than long discs; heel of adpressed hind-limb reaches anterior edge of eye; shank 46.3-53.5 ($\bar{x}$ = 49.3, N = 11)% SVL in males, 45.4-53.5 ($\bar{x}$ = 50.4, N = 10) in females.

In preservative, gray with cream dorsolateral bands; dorsolateral band runs obliquely across flank to merge with creamy-white areas in groin (Fig. 4); dorsum gray with brown (light and dark) stripes; brown stripes also spotted irregularly with black; labial bars and canthal stripe brown; supratympanic stripe broken up into a band of black flecks; limbs pale brown or cream with brown bars flecked with black; shank bars oblique, as wide as interspaces (interspaces sometimes divided by thin brown bar); groin and anterior thighs brown with large cream spots edged with black; posterior thighs brown with occasional cream spots; concealed shank barred cream and brown; venter and undersides of limbs cream, speckled with brown (belly appears gray, throat pale gray).

In life, *E. luteolateralis* is brown striped with darker brown. The dorsolateral stripes are pale creamy-brown. The venter is dark gray to nearly black flecked with cream. The posterior thigh is dark gray. The spots in the groin and on the anterior thighs are bright lemon yellow. The vocal sac is dirty-white. The iris is pale-bronze with a brown horizontal streak.

Measurements of holotype in mm.—SVL 28.8; shank 14.0; head width 10.2; upper eyelid width 3.0; IOD 2.8; tympanum length 1.2; eye length 3.8; E-N 3.4. The holotype is an adult female having extensively convoluted oviducts and large, yellow ovarian eggs.

Etymology.—Latin, in reference to the yellow spots on the lower flanks.

Natural history.—All specimens of *E. luteolateralis* were found at night along the forest edge or streams. All were sitting on vegetation 0.5-2.0 m above the ground. Only 10 specimens were found in 14 days of collecting in July 1968. Eleven were collected in two nights in August 1970. In 1968 the trails were broad and open; in 1970, the trails were comparatively overgrown. These data suggest that *E. luteolateralis* may not be a forest-edge species but may be more properly considered a forest species, in sharp distinction to the comparably-sized *E. calcarulatus*. No direct evidence of breeding was noted. The largest immature female (non-convoluted oviducts, small eggs) is 24.5 mm SVL.

Distribution.—Known only from the type locality.

Remarks.—*E. luteolateralis* is similar to and perhaps an upland relative of *E. walkeri*. The latter is a smaller frog distributed at lower elevations (220-1270 m) along the Pacific versant and lowlands of Ecuador (Lynch, 1974b).

***Eleutherodactylus nyctophylax* new species**

Fig. 1C

Eleutherodactylus palmeri.—Lynch, 1971, Univ. Kansas Mus. Nat. Hist., Misc. Publ. (53):146-47, fig. 99, 226.

Holotype.—KU 110909, adult male collected at Tandapi, Prov. Pichincha, Ecuador, 1460 m, 18 July 1967 by John D. and Marsha Lynch.

Paratypes.—KU 110896-97, 110899-904, 110906-08, 110910-11, 110914-17, 110919-22, 110924-28, 110930-38, all topotypes taken by J. D. and M. Lynch 15-21 July 1967.

Diagnosis.—(1) skin of dorsum finely shagreened, no dorsolateral folds, that of venter coarsely areolate, discoidal folds prominent; (2) tympanum prominent, higher than long, its length $1/5$ - $2/5$ that of eye in males, $1/3$ - $1/2$ eye length in females; (3) snout acuminate in dorsal view, pointed in lateral profile; snout long; (4) interorbital space flat, no cranial crests, frontoparietal fontanelle exposed; upper eyelid slightly narrower than IOD; (5) prevomerine odontophores prominent, triangular in outline; (6) males with large subgular vocal sac and vocal slits; (7) first finger shorter than second; all bearing discs on broad pads; (8) fingers bearing prominent lateral fringes; (9) series of small tubercles along outer edge of forearm; (10) small conical tubercles on knee, heel; no outer tarsal tubercles; inner edge of tarsus bearing one large tubercle; (11) two metatarsal tubercles; inner elongate, 5-6 times size of round outer; plantar surface areolate; (12) toes bearing prominent lateral fringes, webbed basally; toe pads as large as those of fingers; (13) brown above

with mottling on back; no canthal, supratympanic or labial bars or stripes; limb bars perpendicular; groin, anterior thighs, and concealed shank marbled brown on cream background; posterior thighs deep brown flecked with cream; (14) adults moderate-sized, males 21.9-31.4 mm, females 32.1-37.8 mm SVL.

E. nyctophylax is rather unusual among Group II species in having a large, exposed frontoparietal fontanelle. No obvious relatives are apparent but *E. nyctophylax* is similar to some specimens of what Cochran and Goin (1970) called *E. cruentus*. Both have small papillae at the tip of the snout, lateral fringes on the digits, large digital pads, and little color pattern; *E. nyctophylax* differs in having an angular canthus rostralis, triangular rather than oblique prevomerine odontophores, and in the color pattern on the concealed limb surfaces,

Description.—Head narrower than body, broader than long; head width 37.2-43.0 ($\bar{x}$ = 39.0, N = 20)% SVL in males, 38.0-41.5 ($\bar{x}$ = 40.3, N = 20) in females; snout acuminate and pointed in dorsal and lateral profiles, tip bearing papilla; tip of snout overhanging lower jaw; snout long, E-N 82.9-104.4 ($\bar{x}$ = 93.3, N = 20)% eye length in males, 91.2-117.6 ($\bar{x}$ = 104.9, N = 20) in females; nostrils weakly protuberant, directed laterally; canthus rostralis sharp, angular, weakly concave; loreal region weakly concave, sloping abruptly to lips, lips not flared; interorbital space flat, no cranial crests; upper eyelid width 83.3-107.6 ($\bar{x}$ = 96.1, N = 20)% IOD in males, 61.2-94.4 ($\bar{x}$ = 79.7, N = 20) in females; tympanum higher than long, not prominent, separated from eye by distance equal 1 1/2 times its own length; tympanum length 21.7-37.8 ($\bar{x}$ = 30.8, N = 20)% eye length in males, 25.0-47.4 ($\bar{x}$ = 36.9, N = 20) in females; supratympanic fold obscure; no large tubercles on head; tongue longer than wide, its posterior border feebly notched, posterior 1/4 not adherent to floor of mouth; choanae small, round, not concealed by palatal shelf of maxillary arch; prevomerine odontophores median and posterior to choanae, separated by one-half an odontophore width, low, roughly triangular in outline, bearing 4-10 teeth in a transverse row across posterior border; males with large, subgular vocal sac and vocal slits.

Skin of dorsum and limbs finely shagreened, lacking ridges and warts; one ill-defined wart on upper eyelid; anal opening not extended in sheath; venter and undersides of thighs coarsely areolate; discoidal folds prominent; forearm bearing series of subconical ulnar tubercles; palm areolate; palmar tubercle bifid, thenar tubercle oval; subarticular tubercles round, non-conical; fingers bearing prominent lateral fringes; all digits bearing dilated pads, that of thumb bearing round disc; pads of II-IV bear discs that are broader than long; dilation ratios: I 1.6 (1.5-1.9), II 2.2 (1.9-2.5), III 2.4

(2.1-2.8), IV 2.4 (1.9-2.6); pads rounded apically; first finger shorter than second (Fig. 4).

Heel bearing 1-2 short, conical tubercles amidst several minute tubercles; outer edge of tarsus usually lacking tubercles; inner edge of tarsus bearing one large and 2-4 small tubercles; outer metatarsal tubercle round, flat, 1/5-1/6 size of elongate (length twice width), non-compressed inner metatarsal tubercle; plantar surface areolate; subarticular tubercles round, non-conical; toes bearing prominent lateral fringes and basal webbing (not enclosing basal subarticular tubercle except between IV and V); all toes bearing pads and discs (broader than long), pads non-emarginate, as large as those of fingers; heel of adpressed hind limb reaches eye; shank 45.2-53.9 ($\bar{x}$ = 48.5, N = 20)% SVL in males, 46.6-54.1 ($\bar{x}$ = 50.3, N = 20) in females.

In preservative, brown mottled with darker brown above; side of head and flanks brown flecked with cream; limbs brown with dark brown bars, those on shank perpendicular to limb axis and as wide as or slightly narrower than interspaces; posterior surfaces of thigh chocolate brown punctated with cream (a few individuals have large cream spots on the posterior thigh surface); groin and anterior thighs marbled brown on white to cream background; venter dirty cream flecked with brown.

In life, *E. nyctophylax* is creamy-tan to brown (occasionally pale green) with a diffuse pattern of brown and black. The venter is creamy-white to pale gray. The lower flank, groin, and anterior thigh are white or yellow reticulated with dusky-gray. The posterior thigh is brown flecked with cream. The iris is creamy-gray with pale brown reticulation. The eye just under the eyelids is orange in adults and yellow in small individuals.

Measurements of holotype in mm.—SVL 29.4; shank 13.3; head width 11.4; upper eyelid width 3.1; IOD 3.1; tympanum length 0.9; eye length 3.7; E-N 3.4.

Etymology.—Greek, meaning night watchman; these frogs were abundant and frequently perched on leaves 2-3 m above the ground. After the first few nights of field work we seldom collected *E. nyctophylax*; they seemed to simply watch us as we moved quietly through the forest.

Natural history.—Although frequently encountered by day in the axils of plants, *E. nyctophylax* is clearly active at night. The frogs were abundant and usually seen on vegetation 1-3 m above the ground in both forest-edge and forested situations. The only evidence of reproductive activity was a clasping pair found 3 March 1968. Gravid females were collected in March, July, and August. No calling could be attributed to this species. Females 28.0-32.0 mm have small eggs and weakly convoluted oviducts. Juveniles as

small as 9.7 mm SVL were found on vegetation with the adults. In general, juveniles have darker venters than do adults.

Distribution.—Known only from the type locality.

***Eleutherodactylus parvillus* new species**

Fig. 1F

Holotype.—KU 111345, adult female collected at Tandapi, Prov. Pichincha, Ecuador, 1460 m, 17 July 1967 by John D. and Marsha Lynch.

Paratypes.—KU 111346, 111348-73, topotypes collected 17-28 July 1967.

Diagnosis.—(1) skin of dorsum finely shagreened, lacking tubercles and folds, that of venter coarsely areolate; (2) tympanum prominent, round, its length $1/4$ - $1/3$ that of eye; (3) snout round in dorsal and lateral views, tip bearing papilla, short; (4) interorbital space flat, no cranial crests, generally broader than upper eyelid width; (5) prevomerine odontophores oval, not conspicuous; (6) males with subgular vocal sac and vocal slits; (7) first finger shorter than second; all bearing discs on dilated pads; pads round apically; (8) fingers lacking lateral fringes; (9) no ulnar tubercles or folds; (10) small tubercles on heel and outer edge of tarsus, none prominent; (11) two metatarsal tubercles, outer $1/4$ - $1/6$ size of inner; few supernumerary plantar tubercles; (12) toes lacking lateral fringes and webbing; (13) gray to gray-brown with brown markings, *viz.*, chevrons, suprainguinal bar, interorbital bar, labial bars, supratympanic stripe, limb bars; no canthal stripe; venter cream finely stippled with brown; pigmentless areas along lower flanks, anterior thigh, posterior thigh, and concealed shank; pigmentless areas lemon yellow in life; (14) adults small, males 16.4-19.4 mm, females 22.8-24.8 mm SVL.

By virtue of its small size and lack of any distinctive arrangement of tubercles, *E. parvillus* requires comparison with several other small Group II species. *E. parvillus* differs from most in having a visible tympanum (unlike *E. acuminatus* Shreve, *E. carvalhoi* Lutz, *E. croceinguinis* Lynch, and *E. martiae* Lynch). The finely shagreened skin of *E. parvillus* provides ready distinction from those having tuberculate skin (*E. carvalhoi*, *E. croceinguinis*). The protruding snouts of *E. acuminatus* and *E. paululus* Lynch readily distinguish them from *E. parvillus*; neither has yellow areas on their concealed limbs and flanks. The remaining small Group II frogs include *E. pseudacuminatus* Shreve, *E. trachylepharis* (Boulenger), and *E. walkeri* Lynch. The canthus rostralis is sharp in the first two species, neither of which have yellow patches on the concealed surfaces. *E. walkeri* resembles *E. parvillus* in having conspicuous tympana, shagreened skin, and yellow spots on the concealed surfaces but differs in having narrow lateral fringes on

the digits, more prominent canthus rostralis, polymorphic color pattern, and in having the several yellow spots on the flanks and anterior and posterior surfaces of the thigh enclosed in black areas. *E. walkeri* also has narrower digital pads than does *E. parvillus*.

Description.—Head slightly broader than body, broader than long; head width 33.2-40.6 ($\bar{x}$ = 36.0, N = 14)% SVL in males, 34.4-37.8 ($\bar{x}$ = 36.3, N = 10) in females; snout round in dorsal view (with papilla at tip), angularly rounded in lateral profile; snout short, E-N 68.5-87.5 ($\bar{x}$ = 78.3, N = 14)% eye length in males, 77.0-89.7 ($\bar{x}$ = 84.7, N = 10) in females; nostrils protuberant, directed laterally; canthus rostralis rounded, but evident; loreal region concave, sloping abruptly (not vertically) to lips; lips not flared; interorbital space flat or weakly convex, no cranial crests; upper eyelid width 90.0-110.3 ($\bar{x}$ = 97.6, N = 14)% IOD in males, 78.4-100.0 ($\bar{x}$ = 89.3, N = 10) in females; temporal region nearly vertical; tympanum round, annulus distinct along anterior edge and lower one-half, separated from eye by distance equal 1 1/2 times its own length; tympanum length 20.4-32.8 ($\bar{x}$ = 28.2, N = 14)% eye length in males, 28.1-38.9 ($\bar{x}$ = 31.9, N = 10) in females; choanae small, round, not concealed by palatal shelf of maxillary arch; prevomerine odontophores low, oval, median and posterior to choanae, each about as large as a choana, separated by distance equal choanal width, bearing 0-4 teeth in a clump; tongue large, longer than wide, its posterior border notched, posterior 2/5 not adherent to floor of mouth; with subgular vocal sac and vocal slits.

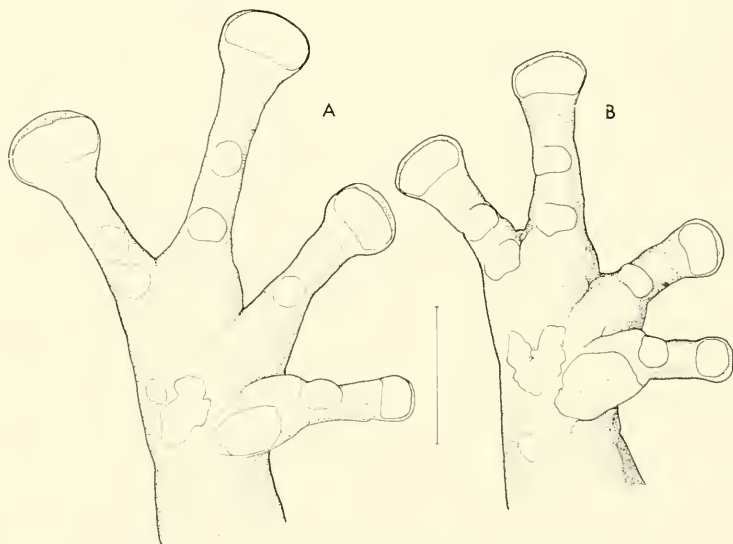


FIG. 5.—Hands of (A) *Eleutherodactylus parvillus*, KU 120244; (B) *E. celator*, KU 131574. Line equals 2 mm.

Skin of dorsum and limbs finely shagreened, lacking prominent tubercles or ridges; anal opening not enclosed in sheath; tubercles below and posterolateral to vent flattened; skin of venter coarsely areolate (less so than skin below vent and on posteroventral surface of thighs; discoidal folds prominent; no ulnar tubercles or folds; palmar tubercle bifid or divided into palmar tubercles, the outer much smaller than inner (Fig. 5); thenar tubercle oval; 3-5 subconical supernumerary palmar tubercles, all less than one-half size of round, non-conical subarticular tubercles; fingers lacking lateral fringes; all fingers bearing discs (broader than long) on dilated pads; dilation ratios: I 1.35 (1.2-1.5), II 2.0 (1.8-2.4), III 2.2 (2.0-2.5), IV 2.2 (1.8-2.5); dilation slightly greater for females than males; pads rounded apically; first finger shorter than second.

Heel bearing small tubercles; outer edge of tarsus bearing row of small tubercles; inner edge of tarsus lacking tubercles; outer metatarsal tubercle slightly longer than wide, subconical, 1/4-1/6 size of elongate (length twice width), non-compressed inner metatarsal tubercle; supernumerary plantar tubercles at bases of toes II-IV, low, nearly indistinguishable; subarticular tubercles low, round; toes lacking lateral fringes and webbing; all toes bearing discs on dilated pads; discs broader than long; pads rounded apically; toe pads smaller than those of fingers; heel of adpressed hind limb reaches tympanum; shank 43.4-50.0 ($\bar{x}$ = 46.7, N = 14)% SVL in males, 43.9-49.3 ($\bar{x}$ = 46.4, N = 10) in females.

In preservative, gray to gray-brown above with brown markings (*viz.*, chevrons, suprainguinal bar, interorbital bar, labial bar, supratympanic stripe); no canthal stripe, no markings on upper arm; forearm, thigh, shank, and tarsus barred; bars on shank oblique and as wide as interspaces; venter cream speckled with brown; undersides of limbs densely speckled with brown; posterior lower flank and anterior surface of thigh bearing pigmentless areas; similar area on distal one-half of posterior thigh surface; rest of thigh stippled brown; anal triangle darker brown; in some individuals the throat is densely stippled with brown.

In life, *E. parvillus* is pale orange-brown to brown with dark brown markings. The vocal sac of males is yellow. The venter (and throat in females) is gray. The groin, anterior thigh, and posterior thigh bear lemon yellow spots. The iris is yellow-bronze, gray-brown, or reddish-brown with a red horizontal streak.

Measurements of holotype in mm.—SVL 22.4; shank 10.4; head width 8.2; head length 7.6; upper eyelid width 2.0; IOD 2.6; tympanum length 1.1; eye length 2.8; E-N 2.5. The holotype is an adult female with extensively convoluted oviducts and moderate-sized, yellow ovarian eggs.

Etymology.—Latin, diminutive of *parvus*, in reference to the

species being the smallest eleutherodactyline frog species found at Tandapi.

Natural history.—No evidence of breeding was found. The largest non-adult female (non-convoluted oviduct, small eggs) is 22.5 mm. None of the females collected have large eggs although the oviducts are extensively convoluted and the eggs of moderate size. *Eleutherodactylus parvillus* is a nocturnal, arboreal frog. Specimens were found during the day in the axils of elephant ear plants. At night the frogs were found sitting on vegetation 0.5-2.0 m above the ground along the forest edge.

Distribution.—Known only from the type locality.

The two species described below belong to an assemblage found at a higher elevation than the Tandapi faunule. The higher elevation faunule has been sampled at La Delicia (Imbabura Prov.), Los Alpes (Pichincha Prov.), and Pilalo (Cotopaxi Prov.). *Eleutherodactylus surdus* (Boulenger) was encountered at all three localities.

Eleutherodactylus celator new species

Holotype.—KU 131573, an adult female collected at La Delicia, Cordillera del Intac, Prov. Imbabura, Ecuador, 2700 m, 5 August 1970 by John D. Lynch.

Paratypes.—KU 131574-88, taken syntopically with holotype.

Diagnosis.—(1) skin of dorsum finely areolate, no dorsolateral folds, that of venter coarsely areolate, discoidal folds prominent; (2) tympanum visible, round, its length $1/3$ - $3/5$ that of eye; (3) snout subacuminate in dorsal view, rounded in lateral profile, tip not pointed; (4) interorbital space flat, much broader than upper eyelid; (5) prevomerine odontophores prominent, triangular in outline; (6) males lacking vocal sac and slits; (7) first finger shorter than second; all digits short, bearing discs on broadly dilated pads; (8) fingers bearing narrow lateral fringes; (9) no ulnar tubercles or fold; (10) no tubercles on knee, heel, or tarsus; (11) two metatarsal tubercles, inner elongate, 5-6 times size of subconical outer; plantar surface areolate; (12) toes bearing narrow lateral fringes; toe pads as large as those of fingers; (13) dorsum brown with darker brown chevrons, interorbital bar, canthal and supratympanic stripes, and labial bars; venter cream stippled with brown; some individuals have a pattern of brown stripes; (14) adults small, males 19.6-21.4 mm, females 22.0-24.5 mm SVL.

Eleutherodactylus celator is most similar to *E. parvillus*. It differs from the other small group II species in the same ways as does *E. parvillus*. Both species have proportionately shorter digits than do the other small group II species. Unlike *E. parvillus*, *E. celator* lacks vocal sac and slits and lacks unpigmented areas in the groin and concealed hindlimb in preserved specimens and likewise lacks

the lemon-yellow flash colors in life. *E. celator* has canthal stripes whereas *E. parvillus* lacks them. *E. celator* may also be distinguished from *E. parvillus* on the basis of head shape, having more prominent prevomerine odontophores, and in having lateral fringes on the digits. The two also differ in the texture of the dorsum (more coarse in *E. celator*).

Description.—Head as broad as body in males, narrower than body in females, longer than wide; head width 30.9-35.0 ($\bar{x}$ = 32.4, N = 15)% SVL; snout subacuminate in dorsal view, rounded in lateral profile; snout short, E-N 80.8-97.4 ($\bar{x}$ = 89.1, N = 6)% eye length in males, 87.0-106.7 ($\bar{x}$ = 93.2, N = 6) in adult females; nostrils weakly protuberant, directed dorsolaterally; canthus rostralis rounded; loreal region weakly concave, sloping gently to lips; lips not flared; interorbital space flat, no cranial crests; upper eyelid width 70.0-90.2 ($\bar{x}$ = 81.3, N = 14)% IOD; temporal region nearly vertical; tympanum round, not prominent, separated from eye by distance equal $1\frac{1}{2}$ times its own length; tympanum length 32.5-43.6 ($\bar{x}$ = 39.0, N = 6)% eye length in males, 41.3-57.8 ($\bar{x}$ = 48.0, N = 6) in females; ear size in juvenile females more like that in males (39.5-40.9, $\bar{x}$ = 40.3, N = 3); choanae small, round, not concealed by palatal shelf of maxillary arch; prevomerine odontophores triangular in outline, prominent, median and posterior to choanae, each larger than a choana, separated by $1\frac{1}{2}$ choanal widths, bearing 2-4 teeth in a transverse row across posterior border; tongue longer

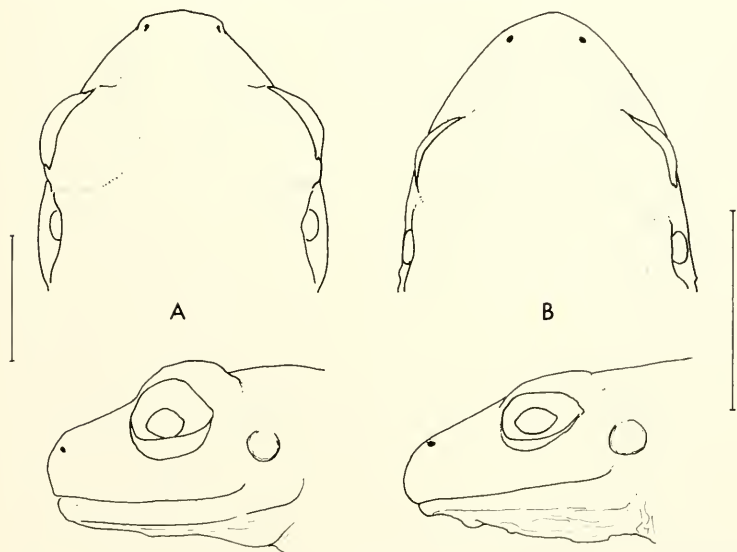


FIG. 6.—Dorsal and lateral views of heads of *Eleutherodactylus parvillus* (KU 120243, A) and *E. celator* (KU 131578, B). Lines equal 5 mm.

than wide, posterior border feebly notched, posterior $2/5$ not adherent to floor of mouth; males lacking vocal sac and vocal slits.

Skin of dorsum and limbs finely areolate (coarsely shagreened), lacking tubercles and ridges; anal opening not enclosed in sheath; skin of venter, underside of thighs, and posterior thighs lateral to vent coarsely areolate; discoidal folds prominent; no ulnar tubercles or folds; palmar tubercle bifid, larger than oval thenar tubercle; palm bearing no supernumerary tubercles or several very indistinct tubercles; subarticular tubercles low, flat, round or slightly broader than long; fingers bearing narrow lateral fringes; all fingers bearing discs (broader than long) on dilated pads, pads rounded apically (Fig. 5); first finger shorter than second.

Knee, heel, and tarsus lacking tubercles; outer metatarsal tubercle subconical, round, $1/5$ - $1/6$ size of elongate, non-compressed inner metatarsal tubercle; plantar surface weakly areolate, many supernumerary tubercles; subarticular tubercles small, round, simple; toes bearing narrow lateral fringes, lacking webbing; all toes bearing discs and pads, pads of toes as large as those of fingers, rounded apically; heels of flexed legs overlap; heel of adpressed hindleg reaches between tympanum and posterior corner of eye; shank 41.5-46.9 ($\bar{x} = 43.7$, $N = 13$)% SVL in adults, 46.6-48.6 ($\bar{x} = 47.8$, $N = 3$) in juvenile females.

In preservative, tan with brown markings (*viz.*, interorbital triangle, sacral and suprainguinal chevrons, slanted bars on upper flanks; *or* vertebral, paravertebral, and dorsolateral stripes); canthal and supratympanic stripes and labial bars brown; flanks creamy-gray; anal triangle pale brown; limbs gray with diffuse oblique brown bars, bars as wide as interspaces; venter cream with fine brown stippling (without magnification venter appears dirty-cream); concealed limb surfaces and groin cream stippled with brown. Six specimens exhibit the striped color pattern and 10 have a pattern of chevrons.

In life, *E. celator* is reddish-brown, medium-brown, or tan with brown, reddish-brown, or black markings. The dorsolateral stripes (if present) tend to be black enclosing a fawn-yellow to pale rust area. Some individuals have white flecks on the dorsum. One individual was pale grayish-cream with pale gray markings. The concealed limb surfaces are colorless or pale orange. The venter was yellow, dirty cream, or pale gray after the frogs were held in live jars for 6-8 hours; when they were removed from bromeliads their venters were nearly black. The throat of males was more lemon-yellow than the venter. The iris is deep chocolate brown with a darker brown horizontal streak.

Measurements of holotype in mm.—SVL 23.8; shank 10.5; head width 7.6; head length 7.8; upper eyelid width 1.8; IOD 2.5; tympanum 1.1; eye length 2.4; E-N 2.4. The holotype is an adult

female with extensively convoluted oviducts and small to medium-sized eggs (< 1.5 mm diameter).

Etymology.—Latin, meaning a hider, in reference to the occurrence of the frog in terrestrial bromeliads.

Natural history.—All sixteen specimens were collected from terrestrial bromeliads along the edge of the road. Fourteen frogs were found singly and one bromeliad yielded two frogs. When S. R. Edwards visited the locality a few days later he collected in the cloud forest at night and collected no specimens of *E. celator*. He did not search along the roadcut where terrestrial bromeliads abound. The largest juvenile female (straight oviducts, minute eggs) is 20.7 mm SVL; the smallest adult female is 22.0 mm SVL.

The testes are large in all males and are brown with a darker brown reticulation. The ovarian peritoneum and some gut linings are peppered with brown. The bases of the thumbs are swollen in males.

Distribution.—Known only from the type locality.

Eleutherodactylus thymalopsoides new species

Fig. 1E

Holotype.—KU 131533, adult female collected at Pilalo, Prov. Cotopaxi, Ecuador, 2460 m, 3 July 1970 by Thomas H. Fritts.

Paratypes.—KU 131534-37, taken syntopically with holotype.

Diagnosis.—(1) skin of dorsum finely granular, forming numerous short ridges; thin dorsolateral folds present; skin of venter areolate; discoidal folds present; (2) tympanum distinct, higher than long, its length $2/5$ that of eye; (3) snout round in dorsal view, round in lateral profile; (4) interorbital space furrowed, cranial crests present; upper eyelid narrower than IOD; (5) prevomerine odontophores large, oval to triangular in outline; (6) males lacking vocal sac and slits; (7) first finger slightly shorter than second; all fingers bearing discs on broad, non-emarginate pads; (8) fingers bearing lateral fringes; (9) ulnar tubercles non-conical; (10) knee, heel, and outer edge of tarsus bearing small, non-conical tubercles; inner tarsal tubercle present; (11) two metatarsal tubercles, inner 6-8 times size of round outer; few supernumerary plantar tubercles; (12) toes bearing narrow lateral fringes but no webbing; toe pads large, but smaller than those of fingers; (13) brown above without pattern; limb bars oblique; venter gray; flanks, anterior and posterior thigh surfaces, top of thigh, and sometimes concealed shank bearing cream spots edged with black; in life the cream spots are yellow with orange centers; (14) adults large, two males 28.0-34.4 mm, three females 51.7-55.4 mm SVL.

E. thymalopsoides is a large Group II species with no apparent relatives. The combination of cranial crests, dorsolateral folds, lateral fringes on the digits, and nearly clean plantar surface sug-

gests a relationship with *E. vertebralis* (Boulenger). The prevomerine odontophores are low and oblique in *E. vertebralis* unlike the massive, transverse (oval to triangular outline) odontophores in *E. thymalopsoides*; *E. thymalopsoides* is considerably larger than *E. vertebralis*.

Description.—Head as wide as body, wider than long; head width 34.9-38.8 ($\bar{x}$ = 36.4, N = 5)% SVL; snout round in dorsal view, rounded (nearly truncate) in lateral profile; snout short, E-N 85.9-93.6% eye length in males, 94.3-101.0% in females; nostrils not or very slightly protuberant, directed dorsolaterally; canthus rostralis moderately sharp, weakly concave; loreal region weakly concave, sloping gradually to lips; lips not flared; interorbital space depressed, edges of frontoparietals upturned forming cranial crests diverging anterior to eyes; upper eyelid width 90.0-94.1% IOD in males, 67.7-81.5% in females; tympanum prominent, slightly higher than long, its length 32.0-32.3% eye length in males, 37.7-38.9% in females; tympanum separated from eye by distance equalling twice its own length; choanae round, small, not concealed by palatal shelf of maxillary arch; prevomerine odontophores 3-4 times size of choanae, slightly posteromedial to choanae, round to triangular in outline, separated by distance equal odontophore width, bearing a row of 3-5 fang-like teeth along posteromedial border; in KU 131536, the prevomerine teeth are not fang-like and are more numerous (7-9 per odontophore); tongue longer than wide, weakly notched along posterior edge, posterior 2/5 not adherent to floor of mouth; males lack vocal sac and slits.

Skin of dorsum and limbs finely granular, granulations anastomose forming short ridges; upper flank bearing thin, warty dorso-lateral fold; large, non-conical tubercles on upper eyelid, scattered on back and limbs; skin of flanks, venter, and underside of thighs areolate, that on throat smooth or weakly granular; discoidal folds prominent; anal opening not enclosed in sheath; two large postanal tubercles on areolate skin below vent; forearm bearing series of round, non-conical ulnar tubercles; two palmar tubercles, partially joined, inner larger than outer, neither as large as oval thenar tubercle; palm bearing many supernumerary tubercles, all flat and smaller than subarticular or palmar tubercles; subarticular tubercles round, subconical; fingers bearing lateral fringes; all fingers bearing discs (broader than long) on broad pads; pads not emarginate; dilation ratios: I 1.4 (1.2-1.7), II 2.1 (1.9-2.6), III 2.7 (2.4-3.2), IV 2.6 (2.0-2.9), pads largest on females; first finger slightly shorter than second (tip of adpressed I reaches middle of disc of II).

Heel and knee bearing 1-2 (usually 2) small, non-conical tubercles; outer edge of tarsus bearing series of 3-4 widely spaced subconical tubercles; a single, round tubercle on inner edge of tarsus just proximal to elongate (length 2-2½ times width), non-compressed

inner metatarsal tubercle; outer metatarsal tubercle subconical, round, 1/6-1/8 size of inner; one (rarely 2) flat supernumerary plantar tubercle proximal to subarticular tubercles of toes II, III, IV (and sometimes V); outer edge of foot bearing series of conical tubercles; subarticular tubercles round to slightly longer than wide, non-conical; toes bearing narrow lateral fringes, not webbed (except for coalescing lateral fringes); toes long and slender, all bearing discs and pads, pads (largest to smallest) IV, V, III, II, I; all toe pads smaller than those of fingers; discs broader than long; hindlimbs short, heel of adpressed hindlimb reaches to between tympanum and eye, when legs are flexed at right angles to sagittal plane, heels barely overlap, shank 47.4-53.9% SVL in males, 45.3-47.5% in females.

In preservative, brown to dark brown above with little indication of pattern; limbs barred with dark brown, bars on shank oblique and slightly narrower than interspaces; flanks brown becoming gray toward venter; venter dark gray suffused with brown (but paler than dorsum or flanks); flanks, anterior and posterior thigh surfaces, top of thigh, and sometimes concealed shank, bearing irregular-shaped cream spots edged with black; ground color on posterior thighs chocolate-brown.

In life, *E. thymalopsoides* was black with a faint green suffusion and cream stripe on the lips. The spots on the concealed surfaces were yellow with orange centers in the larger individuals or yellow in smaller individuals. The day after collected, the frogs were fawn-brown with dark brown and green wash dorsally. The upper flanks were pale blue barred with light and dark brown. The venter and concealed limbs were bluish-gray. The iris was bright copper with a diffuse reddish-brown horizontal streak.

Measurements of holotype in mm.—SVL 55.3; shank 25.5; head width 19.7; head length 16.9; upper eyelid width 4.4; IOD 5.4; tympanum length 2.0; eye length 5.3; E-N 5.0. The holotype is an adult female with extensively convoluted oviducts and eggs of moderate size; each prevomerine odontophore bears 5 teeth.

Etymology.—Greek, *thymalops* (live coal), *oides* (bearing), in reference to the bright spots on the flanks and limbs.

Natural history.—All five specimens were collected in the axils of large terrestrial bromeliads on an exposed cliff during the day. The locality lies within cloud forest and no specimens were encountered during nightly searches in the forests or along the cliff base. No attempt was made to scale the steep cliff at night. The testes of the larger male (KU 131535) are stippled brown; the thumb of this individual is not swollen. The smaller male (KU 131534) has swollen thumbs but the testes are creamy-white. KU 131536 is a female 51.7 mm SVL with moderate convolution of the oviducts and small ovarian eggs. The other two females are slightly larger

(55.3-55.4 mm SVL), have extensive oviducial convolution and larger, white ovarian eggs.

Distribution.—Known only from the type locality.

DISCUSSION

Habitat separation provides some indication of resource partitioning by the eight species of *Eleutherodactylus* found at Tandapi. Frogs were found in three habitat sections—deep forest, forest-edge, and meadow. All eight species are nocturnal; three are terrestrial (*E. achatinus*, *E. crenunguis*, and *E. w-nigrum*) and five are arboreal (*E. calcarulatus*, *E. crucifer*, *E. luteolateralis*, *E. nyctophylax*, and *E. parvillus*). Two of the terrestrial species (*E. achatinus* and *E. w-nigrum*) are found in meadows and each also occurs in the forest edge but at lower densities. These two species are also ecologically separated in that *E. w-nigrum* was most frequently found in seepage areas and along small rivulets whereas *E. achatinus* frequented less mesic microhabitats.

Six species were found in forest-edge habitats. In addition to *E. achatinus* and *E. w-nigrum*, a third terrestrial species, *E. crenunguis*, was infrequently collected; *E. crenunguis* frequented the less mesic microhabitats but its absence from seepage areas and rivulets may be an artifact of its relative rarity. The other three species in the forest-edge are arboreal. One (*E. calcarulatus*) was found nowhere else; the other two (*E. nyctophylax* and *E. parvillus*) were less frequently encountered in the forests. *E. parvillus* was almost always found on large-leafed plants whereas the other two arboreal forest-edge species exhibited no selectivity for leaf size.

In addition to the terrestrial *E. crenunguis* and the arboreal *E. nyctophylax*, *E. parvillus*, *E. crucifer* and *E. luteolateralis* were found in forested habitats. *E. luteolateralis* was found in the same settings as *E. nyctophylax* and *E. parvillus*, but *E. crucifer* was found on moss-encrusted leaves.

Hutchinson (1965), Hutchinson and MacArthur (1959), and MacArthur and Levins (1964) suggested that niche separation might be effected by size differences, because raptorial organisms feeding on one resource substrate would use different proportions of that substrate. Hutchinson and MacArthur (1959) found a size difference of approximately 130:100 sufficient to permit ecological sympatry.

Size differences are apparent between the species of *Eleutherodactylus* at Tandapi (Table 1) but some species do not differ in size (*E. calcarulatus*, *E. crucifer*, and *E. luteolateralis*). The magnitude of sexual dimorphism is relatively constant ($\bar{x} = 1.38$). Computing ϕ values for the species at Tandapi in the several ecologic contingencies one notes that most values are lower than that Hutchinson and MacArthur (1959) adopted (1.28). The closest approximations to Hutchinson and MacArthur's ϕ are for the terrestrial and

TABLE 1. MEAN SIZES OF TANDAPI ELEUTHERODACTYLUS

	♂ ♂	♀ ♀	$\bar{x}$ SVL ♀ / $\bar{x}$ SVL ♂
<i>E. parvillus</i>	18.7(± 0.4)14 ¹	23.6(± 0.8)6	1.26
<i>E. crucifer</i>	19.4(± 0.5)9	27.7(± 1.5)3	1.43
<i>E. calcarulatus</i>	22.3(± 0.6)21	26.8(± 0.4)20	1.20
<i>E. luteolateralis</i>	22.0(± 0.7)10	27.9(± 1.4)5	1.27
<i>E. nyctophylax</i>	26.8(± 1.0)21	33.8(± 0.8)22	1.26
<i>E. achatinus</i>	29.5(± 1.3)17	43.0(± 1.2)13	1.46
<i>E. w-nigrum</i>	32.9(± 2.4)24	58.6(± 1.9)22	1.78
<i>E. crenunguis</i>	41.8(± 5.8)5	—	—

¹ $\bar{x}(\pm 2 \text{ SE})N$

non-forest species. That the $\bar{x} \phi$ values for subunits (forest, forest-edge, non-forest) are higher than for the entire fauna or the arboreal species is suggestive that size differentiation is a means of resource partitioning in the *Eleutherodactylus* community at Tandapi. The lower interspecies ϕ values compared to the intra-species values (ϕ / δ sizes) and to Hutchinson and MacArthur's (1959) ϕ value may be interpreted as evidence of a competitive equilibrium between sexes and of narrower niches in tropical environments.

SUMMARY

Eight species of *Eleutherodactylus* were found at Tandapi, Pichincha Province, Ecuador, a town in the cloud forest on the Pacific slopes of the Andes at 1460 m elevation. Five of the eight species are named here. *Eleutherodactylus crenunguis* is a species of the *E. fitzingeri* group having no known close relatives. It resembles species from southeastern Brasil in having notched digital pads but differs in having flared lips. *Eleutherodactylus calcarulatus* is a small species allied to *E. frater*, *E. ockendeni*, and *E. taeniatus* but differs in having a prominent calcar on the heel and in coloration. *Eleutherodactylus luteolateralis* is a small species related to *E. walkeri* but differs in size and coloration. *Eleutherodactylus nyctophylax* is a moderate-sized species having no known

TABLE 2. ϕ VALUES FOR TANDAPI ELEUTHERODACTYLUS

Contingency	$\delta \delta$ $\bar{x}(\text{range})N$	$\phi \phi$ $\bar{x}(\text{range})N$	$\bar{X}$
Entire fauna	1.13(0.98–1.27)7	1.17(0.97–1.36)6	1.15
Arboreal sp.	1.07(0.98–1.22)4	1.10(0.97–1.21)4	1.08
Forest sp.	1.24(1.04–1.56)4	1.13(1.01–1.21)3	1.19
Forest-edge sp.	1.18(1.10–1.27)5	1.26(1.14–1.36)4	1.21
Non-forest sp.	1.12	1.36	1.24
Terrestrial sp.	1.20(1.12–1.27)2	1.36	1.25

close relative but resembling a smaller frog reported from Colombia under an incorrect name (*E. cruentus*) by Cochran and Goin (1970). The two differ in size, coloration, and the exposure of the frontoparietal fontanelle in *E. nyctophylax*. *Eleutherodactylus parvillus* is a small species having no apparent close relatives. It has large yellow patches in the groin and on the concealed areas of the hind limb. *Eleutherodactylus calcarulatus*, *E. luteolateralis*, *E. nyctophylax*, *E. parvillus* are species of the *E. unistrigatus* group. In addition to the new species, *E. achatinus* and *E. w-nigrum* (*E. fitzingeri* group) and *E. crucifer* (*E. unistrigatus* group) occur at Tandapi.

Two other species are named from a biotic zone found at slightly higher altitudes on the Pacific Andean slopes of Ecuador. *Eleutherodactylus celator* is a small species similar to *E. parvillus* but differing in lacking vocal apparatus, in having shorter digits, in head shape, and in coloration. It is found at La Delicia, Imbabura Province, at 2700 m. *Eleutherodactylus thymalopsoides* is named from Pilalo, Cotopaxi Province, at 2460 m. It is a large species of the *E. unistrigatus* group apparently related to *E. vertebralis* but differing in size, coloration, and in having massive prevomerine odontophores.

The eight species of *Eleutherodactylus* found at Tandapi partition the available habitat by ecological parapatry (*viz.*, meadow, forest-edge, and forested microhabitats) and size differentiation. The size differentials between ecologically sympatric species are generally less than those reported for North Temperate organisms. The most obvious size differential among the eight species is sexual dimorphism.

RESÚMEN

Ocho especies de sapos del género *Eleutherodactylus* se encontraron en la localidad de Tandapi, Provincia de Pichincha, Ecuador. Este villorio está ubicado en la región de selva húmeda de la ladera occidental de los Andes ecuatorianos a 1460 m de altura.

De los ocho especies, cinco constituyen la preocupación de este estudio. *Eleutherodactylus crenunguis* es una especie del grupo de *E. fitzingeri*, al cual no se le conocen parientes cercanos. Se asemeja a especies del sudeste del Brasil al tener almohadillas digitales escotadas, pero diferenciándose por la presencia de labios extendidos. *Eleutherodactylus calcarulatus* es una especie pequeña aliada a *E. frater*, *E. ockendeni*, y *E. taeniatus* de los cuales difiere por tener un calcáneo prominente en el talón, y también por su coloración. *Eleutherodactylus luteolateralis* es otra especie pequeña, relacionada con *E. walkeri* pero diferenciándose por su tamaño y color. *Eleutherodactylus nyctophylax* es una especie de tamaño mediano que no tiene parientes cercanos, pero que se asemeja a un pequeño sapo indicado por Cochran y Goin (1970) para Colombia

bajo un nombre incorrecto (*E. cruentus*). Los dos se separan por el tamaño, coloración, y por la exposición de la fontanella frontoparietal que ocurre en *E. nyctophylax*. *Eleutherodactylus parvillus* es otra pequeña especie que parece no tener afinidades cercanas: tiene grandes manchas amarillas en las ingles y en los partes no expuestos de los miembros posteriores.

Los especies *E. calcarulatus*, *E. luteolateralis*, *E. nyctophylax*, y *E. parvillus* pertenecen al grupo de *E. unistrigatus*.

Junto a ellas, las nuevas especies, *E. achatinus* y *E. w-nigrum* (del grupo *E. fitzingeri*) y *E. crucifer* (del grupo *E. unistrigatus*) también ocurren en Tandapi.

Dos otras especies son descritas para una zona biótica de una ligera mayor altitud en la ladera del Pacífico de los Andes ecuatorianos. *Eleutherodactylus celator* es una especie pequeña similar a *E. parvillus* pero diferenciándose por la ausencia de un aparato vocal, por tener dedos anteriores más cortos, por la forma de la cabeza, y por su coloración. Se encuentra en La Delicia, Provincia de Imbabura, a 2700 m de altura. A *Eleutherodactylus thymalopsoides* se lo encuentra en Pilalo, Provincia de Cotopaxi, a 2460 metros. Esta es una especie más grande, del grupo *E. unistrigatus*, aparentemente relacionada con *E. vertebralis* de la cual difiere en tamaño, coloración, y por la posesión de odontóforos prevomerianos abultados.

Los ocho especies de *Eleutherodactylus* encontradas en Tandapi, se reparten el habitat disponible a través de parapatría ecológica (i.e., microhabitats de selva, de bordes de selva, y vegas), y por diferenciación en el tamaño. Los diferencias de tamaño entre especies ecológicamente simpátricas son generalmente menores que aquellas que ocurren entre organismos de las zonas templadas del Norte. La más obvia diferencia de tamaño entre los especies estudiadas se da entre los sexos—dimorfismo sexual.

SPECIMENS EXAMINED

Eleutherodactylus calcarulatus

ECUADOR, *Prov. Imbabura*: La Delicia, 2700 m, KU 132754, 132758-66, 132768-69, 132771-76. *Prov. Pichincha*: Tandapi, 1460 m, BMNH 1969.659-61, KU 111216-40, 111242-75, 111276-79 (cleared and stained skeletons), 117774-75, 120270-76, 131678-83, MCZ 75170-77, 75175-77; Tandapi, 1500 m, KU 135455-57; 2 km E Tandayapi, USNM JAP 2775.

Eleutherodactylus celator

ECUADOR, *Prov. Imbabura*: La Delicia, 2700 m, KU 131573-88.

Eleutherodactylus crenunguis

ECUADOR, *Prov. Pichincha*: Tandapi, 1460 m, KU 111213-15, 120125-31, 131605.

Eleutherodactylus crucifer

ECUADOR, *Prov. Bolivar*: Porvenir, 1760 m, BMNH 99.10.30.45/RR 1947.2.16.91 (holotype). *Prov. Pichincha*: Rio Toachi, USNM GOV 6469; Tandapi, 1460 m, KU 111206-12, 120132-50, 131667-71.

Eleutherodactylus luteolateralis

ECUADOR, *Prov. Pichincha*: Tandapi, 1460 m, KU 111378-84, 120151-54, 131672-77; Tandapi, 1500 m, KU 135448-51.

Eleutherodactylus nyctophylax

ECUADOR, *Prov. Pichincha*: Tandapi, 1460 m, BMNH 1969.654-58, KU 110896-912, 110913 (cleared and stained skeleton), 110914-22, 110923 (cleared and stained skeleton), 110924-74, 111376-77, 117582-83, 130873-86; Tandapi, 1500 m, KU 135428-46, 135459, 138789.

Eleutherodactylus parvillus

ECUADOR, *Prov. Pichincha*: Tandapi, 1460 m, KU 111345-73, 111374-75 (cleared and stained skeletons), 120242-245, 120246 (cleared and stained skeleton), 131603-04; Tandapi, 1500 m, KU 135445, 135452-54.

Eleutherodactylus thymalopsoides

ECUADOR, *Prov. Cotopaxi*: Pilalo, 2460 m, KU 131533-37.

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